

IN THE CLAIMS:

Please amend Claims 4 and 5 as follows.

Please add new Claims 31-33 as follows.

- 01
1. (Previously Amended) An image display apparatus comprising:
- reflective display means;
 - illumination means for illuminating the display means;
 - an illumination optical system for guiding light from the illumination means to the display means;
 - a display optical system for guiding light from the display means to an observation position;
 - a first optical member used in common by the illumination optical system and the display optical system and having only one surface of an optical surface A functioning as a reflecting surface in association with the illumination optical system and as a transmission surface in association with the display optical system; and
 - a second optical member having a refractive power and separated from said first optical member with an air-gap therebetween,
- wherein light from said illumination means is reflected by said optical surface A and is guided to said display means,
- wherein light from said display means is transmitted through said optical surface A and then is transmitted through said second optical member and guided to the observation position,
- wherein, when a reference ray is defined as a ray that is part of illumination light from said illumination means that is reflected at the center of said display means and

emerges therefrom and is incident on the center of a pupil, the following condition is satisfied,

$$20 \text{ deg} < \alpha < 70 \text{ deg},$$

where, when in said illumination optical system the reference ray is reflected at said optical surface A, α is an angle defined by the incident light and the reflected light, and

wherein the reference ray is substantially perpendicularly incident on said display means to emerge substantially perpendicularly therefrom and said display optical system includes a plurality of reflecting surfaces of decentered curvature surfaces in said second optical member.

2. (Original) The image display apparatus according to Claim 1, wherein the optical surface A in the illumination optical system is a reflective curvature surface having a positive refracting power on a local meridional section (a plane including incident light and exit light of the reference ray).

3. (Original) The image display apparatus according to Claim 1, wherein the illumination light source means is an RGB time division light source and the display means displays images of R, G, and B in time division in synchronism with emission of color light beams of R, G, and B from the RGB time division light source.

4. (Currently Amended) The image display apparatus according to ~~Claim 1~~ Claim 1 or 31, wherein an angle $\beta(^{\circ})$ of incidence to the reflective display means, of the reference ray emitted from the illumination light source means satisfies the following condition:

$$-10 < \beta < 10.$$

5. (Currently Amended) The image display apparatus according to ~~Claim 2 or 3~~ Claims 2, 3, 32 or 33, wherein the display optical system includes two or more surfaces with refracting powers differing depending upon azimuth angles, and the entire display optical system has a positive refracting power.

D3 and
6. (Original) The image display apparatus according to Claim 5, wherein in an outermost image on a local meridional section of the display means (a plane including incident light and exit light of the reference ray), an F3 eye center ray represents a ray passing the center of the eye and an outermost image on the far side from the eye, $local_fy(F3)$ is a total focal length in the local meridional section of the display optical system on the F3 eye center ray, $local_fyC(F3)$ is a focal length in the local meridional section on a hit point of the F3 eye center ray on a transmissive surface C with a refracting power closest to the eye, and a ratio of the focal lengths satisfies the following condition:

$$-0.6 < local_fy(F3)/local_fyC(F3) < -0.1.$$

D3
7. (Previously Amended) An image display apparatus comprising:
reflective display means;
illumination means for illuminating the display means;
an illumination optical system for guiding light from the illumination means to the display means;
a display optical system for guiding light from the display means to an observation position;
a first optical member used in common by said illumination optical system and said display optical system and having an optical surface A functioning as a reflecting surface in association with said illumination optical system and as a transmission surface in association with said display optical system; and

a second optical member;

wherein light from said illumination means is reflected by said optical surface A and is guided to said display means;

wherein light from said display means is transmitted through said optical surface A and then is transmitted through said second optical member to be guided to the observation position,

wherein, when a reference ray is defined as a ray which is illumination light from said illumination means that is reflected at the center of said display means and emerges therefrom and is incident on the center of a pupil, and a plane that includes incident light and exit light of the reference ray in each surface is defined as a local meridional section in each surface, the following condition is satisfied,

$$0.1 < \text{local.fyA} / \text{local.fy} < 1.0,$$

where local.fy is a focal length of said display optical system in the local meridional section and local.fyA is a focal length of said optical surface A, and

wherein said display optical system includes a plurality of reflecting surfaces in said second optical member.

8. (Original) The image display apparatus according to Claim 7, wherein the optical surface A having the two functions of transmission and reflection, shared between the illumination optical system and the display optical system, comprises only one surface.

9. (Original) The image display apparatus according to Claim 7, wherein the plurality of reflective surfaces in the display optical system are decentered curvature surfaces.

10. (Original) The image display apparatus according to Claim 7, wherein the display optical system is comprised of an optical member comprising the optical surface A and another optical member having an optical refracting power, said optical members being placed with an air space in between.

D4
encl

11. (Original) The image display apparatus according to Claim 7, 8, 9, or 10, wherein the illumination light source means is an RGB time division light source and the display means displays images of R, G, and B in time division in synchronism with emission of color light beams of R, G, and B from the RGB time division light source.

12. (Original) The image display apparatus according to Claim 9, wherein the display optical system includes two or more surfaces with refracting powers differing depending upon azimuth angles, and the entire display optical system has a positive refracting power.

DS

13. (Previously Amended) An image display apparatus comprising:
reflective display means;
illumination means for illuminating the display means;
an illumination optical system for guiding light from the illumination means to the display means;
a display optical system for guiding light from the display means to an observation position;
a first optical member used in common by said illumination optical system and a display optical system and having an optical surface A functioning as a reflecting surface in association with said illumination optical system and as a transmission surface in association with said display optical system; and

a second optical member,

wherein from said illumination means is reflected by said optical surface A and is guided to the display means;

wherein light from said display means is transmitted through said optical surface A and then is transmitted through said second optical member to be guided to the observation position,

wherein said first optical member has an optical surface B opposed to said optical surface A facing toward said display means so that light from said display means is transmitted through said optical surface A and thereafter is transmitted through said optical surface B, said optical surface A has a curvature and said optical surface B is a curved surface,

wherein, when a reference ray is defined as a ray which is illumination light from said illumination means that is reflected at the center of said display means and emerges therefrom and is incident on the center of a pupil, and a plane that includes incident light and exit light of the reference ray in each surface is defined as a local meridional section in each surface, the following condition is satisfied,

$$0.4 < \text{local.ryA} / \text{local.ryB} < 2.0,$$

where local.ryA and local.ryB are radius of curvature of said optical surface A and a radius of curvature of said optical surface B in the local meridional section, respectively, and have the same sign, and

wherein said display optical system includes a plurality of reflecting surfaces in said second optical member.

14. (Original) The image display apparatus according to Claim 13, wherein the optical surface A having the two functions of transmission and reflection, shared between the illumination optical system and the display optical system, comprises only one surface.

15. (Original) The image display apparatus according to Claim 13, wherein the reflected light from the display means emerge from the lens body and thereafter is reflected by a plurality of reflective surfaces being decentered curvature surfaces to be guided to the pupil.

D4
16. (Original) The image display apparatus according to Claim 13, 14, or 15, wherein said illumination means is a time division light source for emitting a plurality of color light beams in time division and the display means displays images based on respective color beams in time division in synchronism with emission of the color light beams from the time division light source.

17. (Original) The image display apparatus according to Claim 13, 14, or 15, wherein the display optical system includes two or more surfaces with refracting powers differing depending upon azimuth angles, and the entire display optical system has a positive refracting power.

18. (Original) The image display apparatus according to Claim 13, wherein said lens body is comprised of a glass member.

19. (Original) The image display apparatus according to Claim 13, wherein said optical surface A and said curved surface B are cylindrical surfaces.

16
encl

20. (Original) The image display apparatus according to Claim 13, wherein said optical surface A is a half mirror of metal.

21. (Previously Amended) An image display apparatus comprising:

reflective display means;

illumination means for illuminating the display means;

an illumination optical system for guiding light from the illumination means to the display means;

a display optical system for guiding light from the display means to an observation position

07

a first optical member used in common by said illumination optical system and said display optical system and having an optical surface A functioning as a reflecting surface in association with said illumination optical system and as a transmission surface in association with said display optical system; and

a second optical member;

wherein illumination light from said illumination means is reflected by said optical surface A and is guided to said display means;

wherein light from said display means is transmitted through said optical surface A and then is transmitted through said second optical member to be guided to the observation position,

wherein said first optical member has an optical surface B opposed to said optical surface A facing toward said display means so that light from said display means is transmitted through said optical surface A and thereafter is transmitted through said optical surface B, said optical surface A has a curvature and said optical surface B is a curved surface,

D7
pnd

wherein, when a reference ray is defined as a ray that is illuminated light from said illumination means that is reflected at the center of said display means and emerges therefrom and is incident on the center of a pupil, and a plane that includes incident light and exit light of the reference ray in each surface is defined as a local meridional section in each surface, in the local meridional section of a display means surface, the optical path length of a ray, in said first optical member, that passes a most peripheral image on said display means at a far side from the observation position and a center of the pupil is longer than the optical path length of a ray, in said first optical member, that passes a most peripheral image on said display means at a near side from the observation position and the center of the pupil, and,

wherein said display optical system includes a plurality of reflecting surfaces in said second optical member.

D8

22. (Original) The image display apparatus according to Claim 21, wherein a curvature in the local meridional section of said optical curvature surface A of said lens body in said display optical system is larger than a curvature in the local meridional section of said curved surface B.

23. (Original) The image display apparatus according to Claim 22, wherein optical path lengths in the lens body in the display optical system of eye center rays at respective image heights, passing the image heights and the center of the eye, on the local meridional section of said display means, become gradually longer from said F2 eye center ray side to said F3 eye center ray side

D9

24. (Original) A head mounted display comprising the image display apparatus as set forth in either one of Claims 1 to 4, 6 to 10, 12 to 15, and 18 to 23.

25. (Original) A head mounted display comprising the image display apparatus as set forth in Claim 5.

26. (Original) A head mounted display comprising the image display apparatus as set forth in Claim 11.

D10
27. (Original) A head mounted display comprising the image display apparatus as set forth in Claim 16.

28. (Original) A head mounted display comprising the image display apparatus as set forth in Claim 17.

DN
29. (Original) A head mounted display comprising the image display apparatus as set forth in Claim 6.

D12
30. (Previously Added) The image display apparatus according to Claim 1, wherein said first optical member consists of a plurality of members that are cemented together.

D13
31. (New) An image display apparatus comprising:
reflective display means;
illumination means for illuminating the display means;
a first optical member used in common for an illumination optical system and a display optical system and having an optical surface A functioning as a reflecting surface in association with the illumination optical system and a transmission surface in association with the display optical system;

a second optical member having a refractive power and disposed to be apart from said first optical member with an air gap therebetween;

an illumination optical system that guides illumination light from the illumination means that is reflected by said optical surface A to the display means; and

a display optical system that guides light from the display means to be transmitted through said optical surface A and then transmitted through said second optical member to be guided to an observation position,

wherein when a ray which is illumination light from the illumination means, is reflected at the center of the display means and emerges therefrom, and is incident on the center of a pupil is defined as a reference ray, the following condition is satisfied,

$$20 \text{ deg} < \alpha < 70 \text{ deg},$$

where when in said illumination optical system the reference ray is reflected at said optical surface A, α is an angle defined by the incident light and the reflected light, and

wherein the reference ray is substantially perpendicularly incident on said display means to emerge substantially perpendicularly therefrom and said display optical system includes a plurality of reflecting surfaces of decentered curvature surfaces in said second optical member.

32. (New) The image display apparatus according to Claim 31, wherein the optical surface A of said first optical member is a reflective curvature surface having a positive refracting power on a local meridional section (a plane including incident light and exit light of the reference ray).

33. (New) The image display apparatus according to Claim 31, wherein the illumination means comprises an RGB time division light source and the display means

D13
eng

displays images of R, G, and B in time division in synchronism with emission of color light beams of R, G, and B from the RGB time division light source.